BEST AVAILABLE IMAGES

Defective images within this document are accurate representations of the original documents submitted by the applicant.

Defects in the images may include (but are not limited to):

- BLACK BORDERS
- TEXT CUT OFF AT TOP, BOTTOM OR SIDES
- FADED TEXT
- ILLEGIBLE TEXT
- SKEWED/SLANTED IMAGES
- COLORED PHOTOS
- BLACK OR VERY BLACK AND WHITE DARK PHOTOS
- GRAY SCALE DOCUMENTS

IMAGES ARE BEST AVAILABLE COPY.

As rescanning documents *will not* correct images, please do not report the images to the Image Problem Mailbox.

PATENT SPECIFICATION

(11) 1 262 121

1 262 121

DRAWINGS ATTACHED

(21) Application No. 13660/69 (22) Filed 14 March 1969

(31) Convention Application Nos. 18145 (32) Filed 18 March 1968
31383 10 May 1968 in

(33) Japan (JA)

(45) Complete Specification published 2 Feb. 1972

(51) International Classification A 47 l 9/14 F 16 b 17/00 B 01 d 46/02

(52) Index at acceptance
A4F 11A3A3 12D 12J
B1T 366 543 575 576 606 642 647 681 68Y 69X 762 764
E2A E14A

(54) VACUUM CLEANER

(71) We, SANYO ELECTRIC CO. LTD., of 18 Nichome, Keihanhondori, Moriguchi, Osaka, Japan, a Japanese Company, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The invention relates to a vacuum cleaner and more particularly to a vacuum cleaner having a dust collecting system which effectively collects a large volume of dust and dirt.

In conventional vacuum cleaners a cloth bag is employed for filtering air through the cleaner body. Prior to the cleaning operation another disposable filter bag made generally of a piece of paper is inserted within the fixed cloth bag which together forms a filtering system. Upon operation of the cleaner, the sucked in air passes through the filtering system and almost all of the dust carried with the air stream is collected primarily in the paper bag. As this dust collection proceeds, an incalculable number of fine dust particles stick to the entire inner surface of the paper bag resulting in the clogging of fine filtering apertures in the bag with dust particles. This premature clogging of the paper bag tends to obstruct the free passage of sucked in air flow through the cleaner and greatly reduces air suction by the cleaner only minutes after it has been put into operation. As is apparent to those skilled in the art, this reduction of air sucking capability of the cleaners causes the reduction of its dust collecting ability. Therefore, in order to maintain the desired dust collecting capability it becomes necessary to exchange the paper bag for a fresh one well before the old one is substantially filled with the collected dust. However, frequent replacement of the paper bags is troublesome as well as costly. As a paper bag is fragile in nature, some limitations are placed on the maximum dimensions of the bag, which in turn restricts the maximum space within the bag available for the storage of collected dust and dirt. This also necessitates frequent change of dust bags since such bags can accommodate only a small amount of dust removed from the air stream through the cleaner.

Another important disadvantage with the conventional vacuum cleaners lies in the difficulty encountered in disposing of the dust collected during operation. It is therefore highly desirable to provide a vacuum cleaner which completely eliminates the disadvantages referred to above.

According to the invention there is provided a vacuum cleaner comprising a body including a motor fan unit and a dust collecting case detachably connected to said body, there being an inlet fitting on the body adapted to be connected to a suction tubular hose, a dust collecting chamber communicating with said inlet fitting, said dust collecting chamber accommodating the detachable dust collecting case and having an outlet opening which is covered by a filler screen, an elongated passage formed in said body and connected at one end to the outlet opening of the dust collecting chamber and extending toward the position of the motor fan unit, said elongated passage including an elongated filter bag, and an exhaust air chamber formed in said body and extending from the position of said motor fan unit to an outlet of the body, and in which the filter screen has a portion on which dust particles of relatively large size accumulate and are compressed in layers so that an additional filtering medium is formed which is capable of removing dust particles of relatively smaller sizes. The inlet fitting may be formed in the body or in the dust collecting case. In the case where the inlet fitting is formed in the body, the dust collecting chamber has an inlet opening directly communicating with the inlet fitting.

The filter screen which is used for the vacuum cleaner is preferably so shaped as to include a nose portion extending into the dust collecting chamber. This nose portion is so formed that the suction air flow through the inlet fitting blows along a generation line of the nose portion. In order to ensure this

[P

operation guide means may be provided for introducing the suction air flow through said inlet fitting along a generation line of the nose portion.

Preferably, the dust collecting chamber may be so connected to the inlet fitting and the elongated passage that the direction of the air flow is substantially reversed in the dust collecting chamber. The dust collecting case may have an end opening which is closed by a detachable screen lid. This screen lid has an opening adapted to be communicated with the inlet fitting and screen portions adapted to be communicated with the elongated passage.

In the preferred embodiment the inlet fitting may be formed at the top of the body and elongated substantially in a horizontal direction. The elongated passage is positioned beneath the inlet fitting. The dust collecting case is positioned in a cavity formed in the body behind the inlet fitting and the elongated passage. The exhaust air chamber extends substantially horizontally at the bottom of said body. The body may have an opening through which one end of the filter bag in the elongated passage is accessible. This opening is covered by a closable lid. The filter screen is preferably formed in a substantially funnel or saucer shape for receiving dust shaken from the filter bag. The body has an end on which the body may stand upright.

In another embodiment of the invention the dust collecting case is mounted at the front end of the body. The dust collecting case has at its top end an inlet opening communicating with the inlet fitting and an outlet opening communicating with the elongated passage.

Suitable clamp means is provided for securing the dust collecting case to the body.

The vacuum cleaner may include an upper and a lower cleaner body section each of which is secured together to form a main cleaner body. The upper cleaner body has at its front top an inlet fitting for receiving a tubular cleaner hose. The detachable dust collecting case is positioned within the upper body in the area immediately downstream of the inlet fitting in the direction of sucked in air flow through the cleaner. The dust collecting case includes an air inlet communicating with the inlet fitting and a filtering screen for removing relatively large dust and dirt from the air flow through the case, said screen defining the air outlet of the case. The construction of the case is such that dust of greater mass retained from tht air stream by the filter screen accumulates on the screen in layers within the case and is pressed into a compact body under the high pressure force of flowing air stream. In addition to the dust collecting case, a dust bag made preferably of a piece of cloth is provided within the cleaner body downstream of the case with its open end communicating with the screened outlet opening of the dust collecting case. Substantially all the fine dust particles which manage to pass through the filter screen of the dust collecting case are trapped by the cloth bag and dust free flows through the air discharge chamber out of the cleaner body.

Two embodiments of the invention are diagrammatically illustrated by way of example in the accompanying drawings, in which:

Figure 1 is a side elevation view of a vacuum cleaner embodying the invention;

Figure 2 is a plan view of the vacuum cleaner illustrated in Figure 1;

Figure 3 is a bottom view of the vacuum cleaner illustrated in Figure 1;

Figure 4 is a rear end view of the vacuum cleaner illustrated in Figure 1;

Figure 5 is a cross-sectional view taken substantially along the line 5-5 of Figure 4;

Figure 6 is a side elevational view of the cleaner of Figure 1 with the dust collecting casing being removed from the cleaner body;

Figure 7 is a plan view of the cleaner with the dust collecting casing completely removed from the cleaner body;

Figure 8 is a perspective view of the detachable dust collecting unit;

Figure 9 is a cross-sectional view of the vacuum cleaner of Figure 5 with the cleaner body being put in an upright position and with the closed end portion of a dust bag being taken out of the cleaner body through the accessible opening;

Figure 10 is a front perspective view of a pre-filter means suitable incorporated in the present vacuum cleaner;

Figure 11 is a rear perspective view of the pre-filter means:

Figure 12 is a perspective view of a locking mechanism for holding the detachable dust collecting unit in position within the cleaner body;

Figure 13 is a fragmental exploded view of the rear end portion of the vacuum cleaner showing the manner in which upper and lower body sections and an end cover are assembled together;

Figure 14 is a perspective view of the support plate for supporting a filter bag in the compartment immediately downstream of the dust collecting chamber; and

Figure 15 is a sectional view similar to Figure 5 of another embodiment of the invention.

Referring to the drawings and particularly to Figures 1 to 5 inclusive, there is shown a vacuum cleaner embodying the two-stage dust collecting means for filtering dust and dirt from sucked in air in accordance with the invention. The vacuum cleaner is illustrated

as having a cleaner body generally indicated by the reference numeral 20. The cleaner body 20 may preferably be of a hollow cylindrical configuration having a substantially conically shaped front end portion 22 and comprising hollow semi-cylindrical upper and lower body sections 20*a* and 20*b* assembled together in the manner hereinafter described.

As shown in Figure 5, the upper body section 20*a* is integrally provided at the front with a longitudinally extending inlet fitting 24 adapted to be connected to a suction tubular hose (not shown) of the well-known construction. The portion of the surrounding wall of the upper body section 20*a* immediately behind the rear end of the inlet fitting 24 is cut away to form an open space or cavity 26 (Figures 7 and 8) for accommodating a dust collecting case 28 which is hereinafter described. The bottom and rear ends of the cavity are defined respectively by an intermediate support wall 30*a* horizontally extending between the cut-out sides and an upright support wall 30b vertically extending between the rear edge of the bottom wall 30a and the rear arcuate cut-out edge, both the horizontal and upright walls 30*a* and 30*b* being integrally formed with the upper cleaner body 20*a*. The dust collecting casing 28 comprises a boxlike case or receptacle open at one end and closed at the other end. More specifically, the dust collecting case 23 is formed as an independent unit having such a semi-cylindrical configuration that when positioned in place within the cavity 26 it fits perfectly therein to form an integral part of the upper cleaner body section 20*a* which exactly matches with its outer form. As clearly illustrated in Figure 8, the dust collecting case 28 includes a bottom wall 28*a* and a rear wall 28*b* respectively which are joined together by a semi-cylindrical upper wall 28*c*. As shown in Figure 5, the case 28 is adapted to be normally placed in position within the cavity 26 with the bottom wall 28*a* supported on the horizontal support wall 30*a* and its rear wall 28*b* located closely adjacent vertical support wall 30*b*. The horizontal support wall 30*a* includes a front extension 32 which extends forwardly towards the front end of the upper body section 20*a*. This extension wall 32 together with the horizontal support wall 30*a* divides the available space within the hollow cylindrical body 20 into two further portions that is to say upper curved compartment 34 defined between the front extension 32 and the front wall portion of the upper cleaner body 20*a* and a lower elongated compartment 36 formed between the horizontal support wall 30*a* including the extension 32 and the lower body section 20*b* secured to the upper section 20*a* in a manner as hereinafter described. The dust collecting case 28 made as a separate, detachable unit further includes a pre-filtering means adapted to be snugly fitted into the front open end 28*d* of the case 28 and a pair of rearwardly extending projections 42 integrally provided on the rear wall 28*b* for guiding the case into the predetermined position within the cavity 26.

As clearly shown in Figures 10 and 11, the filtering means comprises a filter screen lid or cover 40. This screen lid 40 includes a peripheral support frame or flange 44 having an external form in a vertical cross-section which generally corresponds to that of the dust collecting case 28 at its open end. A plurality of straight ribs 46 extend radially from the peripheral flange 44 to join a ring-shaped rib 48 in the centre area of the flange. In the portion adjacent the top of the support flange 44 the pre-filter lid 40 is provided with an air inlet 50 for allowing air flow through the dust collecting case 28. A filter screen 52 which may be made of plastics materials, fine metal wires or the like, and which has a relatively large mesh size is secured onto the peripheral flange 44, radial ribs 46 and circular centre rib 48 to extend and cover the annular space or gap between the flange and the ring-shaped centre rib 48 except the portion for the inlet opening 50. This radially extending screen 52 forms a radial filter portion of the filter screen lid which provides an air outlet of the dust collecting case 28. The screen lid 40 may preferably have a nose cone 54 rearwardly projecting from the circular rib 48 which comprises a plurality of axial support ribs 54*a* surrounded by a screen 54*b* having a similar construction to that of the screen employed in forming the radial filtering portion 52.

In the above construction, the filter screen lid 40 may be slid into the open front end 28*d* of dust case 28 with the peripheral support flange 44 closely contacting the inner surface of the surrounding semicylindrical wall of the case 28 and with the nose cone portion 54 projecting into the case 28 towards its rear end wall 28*b*. Thereafter, the dust collecting case may be inserted in place within the cavity 26 guided by the pair of projections 42 which ride along a corresponding pair of guide grooves or channels 56 (Figure 7) formed vertically in the exposed surface of the upright support wall 30b. In this position of the dust collecting case 28, the inlet opening 50 of the screen lid comes into direct alignment and communicates woth the inlet fitting 24 of the body section 20*a*. The filter screen lid 40 placed in position within the open front end 28*d* of the collecting case forms a dust collecting chamber 28*e* within the case 28 and defines the outlet portion of the chamber 28*e*.

In addition to the above mentioned dust collecting unit, there is further provided a

dust collecting bag to achieve a two stage dust collection which effects complete and more efficient removal of dust particles from the air stream through the vacuum cleaner. As shown particularly in Figure 5, a dust bag 58 which may be constructed from a piece of cloth or other suitable material is placed within the curved compartment 34. In order to support the dust bag 58 within the compartment 34 against the high pressure flow of sucked in air, there is provided an intermediate support plate 60 (Figure 14) having such suitable outer profile as to enable it to be snugly placed within the enlarged opening 62 (Figure 7) defined by the exposed semi-circular edges which are formed when cutting off the portion of the semicylindrical wall of the upper cleaner body 20*a* immediately behind the inlet fitting 24. The support plate 60 is provided with an axially extending flange 64 to which the open end of the dust bag 58 is attached as shown in Figure 5 in a suitable manner such as by sewing or bonding. A resilient packing member 66 surrounds the entire outer edge of the plate 60. A hole 66*a* is provided in the top region of the packing 66 so that this packing member when put in position together with the plate 60 may not interrupt free and smooth flow of air through the inlet fitting 24 and inlet 50 into the dust collecting chamber 28*e*. The support plate 60 having the dust bag and the packing member attached thereto is positioned within the enlarged opening 62 defined by the exposed semicircular edge of the upper cleaner body section 20*a* with the outer peripheral portion of the packing 66 contacting the locating inner flange 68 integrally formed on the inner surface of the upper body section 20a. In this position of the support plate 60, the cloth dust collecting bag 58 extends entirely into the curved compartment 34, its closed end reaching close to an enlarged opening 70 as illustrated in Figure 5. It will be clear that the plate 60 also serves as a member which forms the front wall of the cavity 26.

The upper front wall portion of the upper cleaner body section 20*a* is provided with an enlarged opening 72 having sufficient size to enable the closed end portion of the dust bag 58 located in the compartment 34 to be removed therethrough for the purpose hereinafter discussed in detail. The cover member 74 normally closes the opening 72. The compartment 34 directly communicates with the lower space or air discharge chamber 36 through the hole 70. Within the front or upstream portion of the chamber 36 there is resiliently supported a motor fan unit 76 of known construction for causing air to flow violently through the cleaner with its suction side confronting the dust bag chamber 34. In the rear portion of the chamber 36 is a box like receptacle 78 which is fixedly secured onto the underside of the horizontal support wall 30*a* and which contains a reel (not shown) for winding up a predetermined length of electric cord for supplying electric power to the motor fan unit 76 of the cleaner from a suitable A.C. power supply line. Only an electric plug 80 which is connected at one end of the electric cord for insertion into a plug socket is illustrated in the drawings. When it is desired to operate the vacuum cleaner, a user may pull out the plug 80 so as to unwind the electric cord from the supply reel a desired length.

A large diameter opening at the rear end of the cleaner body 20 may be covered with a suitable means. In the illustrated embodiment of the invention, this closing means comprises a circular end plate 82 of a simple construction which greatly facilitates its assembly with the body section 20*a* and 20*b*. As shown in Figure 13, the end plate 82 is formed in the upper half portion with a plurality of vertically extending elongated apertures 84 which serve together as an air discharge port when the plate is assembled in position with the body sections. The end cover plate 82 is further provided in the lower portion thereof with a blower air discharge port 86 for receiving a tubular coupling member for a blower attachment when it is desired to use the cleaner as a blower. A relatively small covering 86*a* pivoted to the inner surface of the end plate 82 (see Figure 5) normally shields the blower air discharge port 86*a*. In order to assure the easy and rapid assemblage of the end plate 82 with the cleaner body sections 20*a* and 20*b*, the plate 82 has a generally L-shaped hook projection 88 integrally formed therewith at the outer edge which extends axially rearwardly and includes a recess 88*a*. As a complementary means to this L-shaped hook 88, a rearwardly extending projection 90 is provided near the top of the semi-circular opening at the rear end of the upper cleaner body 20*a*. Further, with respect to this semi-circular rear end of the upper body section 20*a*, there is formed a groove 92 in the semi-circular or arcuate inner edge having an axial width substantially equal to or slightly greater than the thickness of the end plate 82 for receiving the outer peripheral portion of the end plate 82 in assembled relation. A groove similar to the groove 92 is also formed in the arcuate inner edge at the semicylindrical rear end of the lower body section 20*b*.

With the above construction, in order to put the upper and lower cleaner body portions 20*a* and 20*b* and the end cover plate 82 together to form an integrated main cleaner body 20, the circular end cover plate 82 may first be assembled to the upper body section 20*a* by fitting the outer periphery of the end cover plate 82 into the arcuate groove

92 and rotating the cover in either direction until the L-shaped hook 88 comes into close match with the complementary projection 90 on the rear end of the body section 20*a*, to ensure rigid mechanical connection between the plate and the upper body section. The lower cleaner body portion 20*b* is next joined to the upper cleaner body 20*a* by inserting the arcuate inner groove over the remaining or exposing outer edge of the circular end cover plate 82, and placing the front arcuate end 96 of the lower body into the outer mating groove 96*a* (Figure 5) formed around the lower half portion of the cylindrical outer wall near the front end of the upper cleaner body portion 20*a*. To keep the above disclosed components in assembled relation against any shock and forces, the lower semicylindrical cleaner body 20*b* is securely fastened to the bottom of the receptacle 78 as by a screw 98. In addition, an L-shaped fastening bracket 100 may conveniently be placed with one leg portion thereof engaging the retaining projection 100*a* of the cover plate 82 and the outer leg portion contacting the flattened surface 100*b* provided at the lowest region of the rear extreme end of the lower body 20*b*, as shown in Figures 4, 5 and 13. Another fastening screw 102 is employed to join the rear end of the cleaner body portion 20*b* and the end cover plate 82 securely together by the bracket 100. Thus, with the above constructions a simple and quick way of assembling the major covering components is readily attained without requiring any complex members.

Referring now in particular to Figures 5 and 12 of the drawings, a mechanism for locking the detachable dust collecting case 28 in place within the cavity 26 is hereinafter described in detail. As best illustrated in Figure 12, this locking mechanism includes a locking plate 104 comprising an upper and lower portion 104*a* and 104*b*. The locking plate 104 has a pair of push rods 106 fixedly secured to the upper half portion thereof so as to extend forwardly in the longitudinal direction of the cleaner body 20. A generally cup-shaped push member 108 is inserted over each of said pair of push rods for axial sliding movement on the rods and the coil springs 110 placed over the rods 106 between the push member 108 and the locking plate 104 normally bias the members axially towards the free end of the push rods. A stop flange is integrally formed at the free end of each rod 106 as shown in Figure 5 to limit this axial sliding movement of the push members over the rods. A pair of support arms 112 which, at one end, are secured by suitable means to the upright wall 30*b* and connected to the sides of the locking plate 104 by pins at the other end, pivotally support the locking plate approximately at a point intermediate its upper and lower ends such that the push members 108 may extend forwardly through the apertures 114 in the wall 30*b*. The locking lever generally indicated at 116 includes a lower operating end 118 and an upper actuating end 120 connected together by an elongated portion 122. The upper end 120 extends generally perpendicular to the elongated portion 122 of the lever and has a cam edge 120*a* which is sloped in one direction and adapted to engage with a vertical projection 124 formed in the lower portion 104*b* of the locking plate 104 at a point intermediate the opposite sides. As illustrated in Figure 5, the lever 116 may be rotatably secured to the depending portion 126 of the vertical wall 30*b* by a suitable fastening means 128 with the operating end 118 projecting downwardly through the aperture 130 into the lever end accommodating recess 132 formed in the rear end region of the lower cleaner body 20*b* and with the upper end 120 extending towards the projection 124. As another coil spring 134 is positioned between the wall 30*b* and the upper portion 104*a* of the locking plate 104, the locking plate is normally urged to rotate in a clockwise direction (Figure 12) on the pivot pins, bringing the vertical projection 124 into constant engagement with the sloped cam edge 120*a* of the lever 116. With this arrangement, when the lever 116 is caused to rotate in a counter clockwise direction as viewed in Figure 12 by manipulating the operating end in that direction, the cam edge 120*a* of the lever which is inclined downwardly from right to left as seen in Figure 12 and is in close contact with the projection 124 pushes the locking plate 104 in a counter clockwise direction as viewed in Figure 5 against the biasing force of the coil spring 134 urging the pair of push rods 106 together with push members 108 into a forward position in which the push members extend forwardly of the wall 30*b* through the holes 114 as shown in Figure 5. On the contrary, as the lever 116 is caused to move in a clockwise direction as viewed in Figure 12 by hand operation the coil spring 134 forces the locking plate 104 in clockwise direction (as viewed in Figure 5), and the pair of push members 108 are retracted to a position immediately behind the wall 30*b*.

The operation of the locking device is hereinafter described in connection with the above mentioned dust collecting case 20. In order to hold the dust casing 29 in place within the cleaner body 20, it is first inserted into the cavity 26 with the pair of guide projections 42 in the corresponding guide channels 56 formed in the wall 30*b* until it rests directly on the horizontal support wall 30*a*. When the dust collecting case 28 is thus completely fitted in position within the cavity, the lever 116 is moved by hand to thrust the push rods 106 together with the

push members 108 into the forward position as hereinbefore described. As the push rods shift to this forward position, the push members 108 enter the hollow depressions 136 formed in the rear wall 28*b* of the case 28 and drive it forwardly against the resilient packing 66 fitted around the intermediate plate 60 under the biasing force of the coil springs 110 bringing the front edge of the case 28 together with the screen lid 40 into tight pressure engagement with the packing. As the result of this pressure engagement, the intermediate plate 60 with the resilient packing 86 is firmly held in position between the inner flange 68 and the open front end 28*d* of the case 28.

In this condition, the pair of rear projections 42 riding within the guide channels 56 jointly with the push members 108 penetrating into the recesses 136 prevent the transverse movement of the case 28 with respect to the upper cleaner body 20*a* in the direction perpendicular to the longitudinal axis thereof during operation of the cleaner. Further, any vertical movement of the dust collecting case 28 is effectively inhibited by the push members 108 entering and engaging the rear recesses 136 with predetermined force. In this manner, the dust collecting case 28 is positively locked in the cavity 26 against any forces including vibration which tend to remove the case out of the cleaner body 20*a* during operation. When it is desired to remove the dust collecting case 28 for dislodging the dust accumulated within the case as hereinafter described, the user may simply move the lever 116 by hand manipulation in the opposite direction. Such operation causes the push members 108 to move away from the recesses 136 into their retracted position immediately behind the rear upright wall portion 30*b* in the manner already described above.

This in turn releases the dust collecting case 28 of any locking forces and restricting engagement and the dust collecting case 28 is now ready to be taken out of the cavity 26 by hand.

In operation with the dust collecting case 28 fitted and locked in place within the upper body section 20*a* and a suction tubular hose (not shown) connected to the inlet fitting 24 by inserting it into the fitting, the motor fan unit 76 is energized to initiate violent suction of air into the cleaner for effecting vacuum cleaning. During operation of the motor fan unit, air carrying dirt and dust away from the surface to be cleaned rushes through the inlet fitting 24 and the inlet opening 50 into the dust collecting chamber 28*e* within the case 28. This air flow through the inlet 50 towards the rear wall 28*b* of the casing is turned or deflected in an opposite direction by the back wall 28*b* and passes through the screen lid 40, the oval-shaped entrance 62 of the plate 60 and into the dust bag receiving passage 34. From there air flows through the enlarged hole 70 into the chamber 36 and through the vertical apertures 84 in the end cover plate 82 rearwardly out of the cleaner body 20. During this passage, as the air is turned within the case 28 towards the screen lid, dust and dirt of relatively large mass or size such as pieces of rugs or torn pieces of cloth and paper and the like carried by the air stream into the cleaner are filtered from the air by the screen lid 40 having a comparatively large filtering mesh before the air enters the dust bag 58. This dust of large size filtered or trapped by the screen lid 40 accumulates on the radial filter partition 52 of the lid under the nose cone 54 in layer after layer until the dust collecting chamber 28*e* is completely filled up with it. As the trapped dust mass gathers on the lid, it is pressed into compactness by the high pressure jet of air and following dust mass impinging thereon. Thus, an efficient use of the available space within the dust collecting case 28 becomes possible that is to say a relatively large amount of dust can be packed in the predetermined space 28*e* of the dust collecting case. Further, as the dust of larger size is piled and compressed tightly on the screen lid 40 in layers along a bottom generation line of the nose cone portion 54, this compacted body of dirt (Figure 5) serves as an additional filtering medium which remove comparatively smaller size dust including fine particles from the air stream through the chamber 28*e*. Accordingly as the dust collection in the chamber proceeds, the layer of dust piled onto the screen lid 40 covers the entire area of the radial filtering portion 52 of the lid with the thickness of the dust layer becoming greater which results in gradual increase of flow resistance against the air passage through the chamber 28*e*. This increase of flow resistance inevitably lowers the filtering efficiency of the cleaner before the dust collecting chamber 28*e* becomes fully occupied with the collected dust and dirt. At this point, attention should be directed to the fact that the screen lid 40 is formed with the elongated, cone-shaped nose portion 54 which longitudinally projects well into the dust collecting chamber 28*e*. With this construction, even though the dust accumulation proceeds to the point where the whole region of the radial filtering portion 52 becomes covered with a thick layer of compacted dust assemblage, this internally extending nose cone portion provides an additional filtering surface which permits relatively unobstructed passage of air therethrough for trapping a further quantity of larger dirt in an efficient manner within said chamber. The circular baffle flange 138 formed so as to surround the inner end of the inlet opening 50 directs the air flow through

the opening onto the top surface of the nose cone 54, thereby to blow in the direction of a top generation line of the cone 34 and keep that area free of any dust accumulation even when the remaining filtering surface of the cone portion becomes encircled by progressively piled dust. Therefore, it will be apparent that the upper surface of the cone 54 remains to be the only area free of dirt accumulation thereon until substantially all of the available space in the chamber 28*e* is filled with the collected dust, which maintains good filtering effect of the screen lid 40 until such time.

The air which leaves the dust collecting chamber 28*e* may flow through the entrance 62 into the fine mesh cloth filter bag 58. As the air passes through the bag, substantially all of the fine dust particles which could not be trapped by the large mesh screen lid 40 are filtered by this bay from the air before it moves through the motor fan unit 76. Thus, only dust free air is exhausted by the unit through the chamber 36 and through the elongated apertures 84 out of the cleaner. Thus, with our vacuum cleaner, a two step dust filtering or collection from the sucked in air through the cleaner is effected which assures a high speed and large volume of dust entrappment. In actual practice, almost all of the dust and dirt including fine particles carried into the cleaner by the air is initially retained by the screen lid which forms the first filtering stage and a comparatively small amount of fine dust particles pass through the lid 40 to be filtered by the dust collecting bag 58 which constitutes the second filtering stage.

For disposing of the dust body and fine particles collected respectively in the dust box 28 and the cloth bag 58, the user must first deenergize the motor fan unit to stop the cleaning operation of the cleaner and then put the cleaner in an upright position as illustrated in Figure 9 with the plurality of support blocks 140 formed in the end cover plate 82, the hook projection 88 and the bracket 100 resting on the floor (not shown) to support the body in such a position. The handle portion 142 at the front extreme end of the upper cleaner body 20*a* constitutes a convenient means for setting the cleaner upright on the floor by hand. After placing the cleaner in such a vertical position, the cover lid 74 is opened to remove the dust bag 58 from the elongated bag receiving compartment 34 through the opening 72. The gripped end of the bag 58 is then shaken vigorously to shake off the fine dust particles collected in the bag 58 onto the exposed surface of the radial portion 52 of the screen lid 40 surrounded by the outer flange 44 and into the hollow conical space formed in the cone shaped nose portion 54 of the lid 40. Thus, the screen lid 40, in addition to its principle function as a filtering medium for removing relatively large dust and dirt from the sucked in air, serves as a receptacle for receiving the fine dust particles shaken off the dust bag 58. After the fine dust particles originally trapped in the cloth bag are placed on the exposed surfaces of the screen lid 40, the lever 116 is then manipulated to unlock the dust collecting casing 28 permitting it to be withdrawn laterally (as viewed in Figure 9) out of the upper cleaner body portion 20*a*. At this point, the user may first take out the screen lid 40 from the case 28 and then dispose of the quantity of fine dust particles which is held on the exposed side of the funnel or saucer shaped screen lid 40. Thereafter, the user may throw off the compacted mass of dust and dirt collected in the case 28 for example, by turning the casing upside down. As noted above, dust and dirt collected in this casing are pressed tightly into a compact mass or body by the high pressure air stream during operation of the cleaner, the disposal of the dust mass can readily be accomplished simply by inverting and slightly shaking the case without causing the compressed dust body to be broken off into small fragments or be scattered about. The fact that the dust and dirt which accumulate in the dust collecting case are firmly pressed together into a compact assembly greatly facilitates the disposal thereof as hereinbefore noted. When this emptying of dust and dirt collected in the case is finished, the screen lid 40 which is now cleared of any fine dust particles may again be slid and fitted into the front open end 28*d* of the empty casing 28 with the nose cone portion 54 penetrating therein. The dust collecting case having the screen lid 40 placed therein is then inserted into the cavity 26 guided by the rear projections 42 riding along the channels 56 and the lever 116 is again operated by hand to lock the casing 28 in predetermined position within the cleaner body 20 as hereinabove described in detail. Meanwhile, the closed end of the dust bag 58 pulled out of the compartment 34 for removal of the collected dust particles is also placed back into said dust bag receiving compartment 34 with subsequent closure of the access opening 72 by the cover 74.

When all of this has been done, the vacuum cleaner is set horizontal on the floor with a pair of large wheels 146 and a small front wheel 148 supporting and carrying the entire body 20, the cleaner being ready to be operated again for vacuum cleaning of floors, walls, furniture and the like. With respect to the temporal function of the screen lid 40 as a means for receiving an amount of shaken off fine dust particles, the radial filtering portion 52 of the screen lid 40 may preferably be depressed slightly inwards that is to say to the

left as viewed in Figure 10 in the general shape of a bowl.

When it is desired to use the vacuum cleaner as a blower, a suitable tubular hose coupling (not shown) for a blower attachment is inserted through the cylindrical aperture 86 formed in the rear cover plate 82. It can be appreciated that when inserted into the aperture 86 the tubular hose coupling pushes the pivoted shield 86*a* upwardly into a position shown in dotted lines in Figure 5. With the shield plate in its upward position, substantially all of the dust free air flowing rearwardly through the utility room 36 which normally passes through the plurality of vertical apertures 84 is diverted into the hose coupling for the blower tool. Thus, the vacuum cleaner of the invention can readily be converted into a blower device.

Figure 15 illustrates another embodiment of the invention in which the dust collecting case is mounted at the front end of the body. Referring to Figure 15, the vacuum cleaner illustrated therein has a cleaner body generally indicated by the reference numeral 220. The cleaner body 220 may preferably be of a hollow cylindrical or square prism configuration extending in a horizontal direction. The body 220 comprises an upper body portion 220*a* and a lower body portion 220*b* which are joined and fixed to each other to form a complete body. The upper body portion 220*a* cooperates with a top cover plate 274 to define a substantially horizontally extending passage 234 having an inlet opening 264 toward the front end and an outlet opening 270 toward the rear end. These two openings 264 and 270 are both formed in the bottom wall of the upper body portion 220*a*.

The lower body portion 220*b* cooperates with the bottom wall of the upper body portion 220*a* to define a compartment 36 for containing a motor fan unit 276 and a case 278 for an electric cord supplying electric current to the motor fan unit 276 and has a discharge outlet 286 which may be covered by an extension 274*a* of the top cover 274. The extension 274*a* includes a discharge opening which communicates with the discharge opening 286.

The rear end of the extension 274*a* of the top cover 274 is pivotally mounted on a pin 218 supported by a bracket 217 which is fixed to the upper body portion 220*a* at its tail end so that it may open and close the top of the passage 216. The reference numeral 274*b* indicates a hook mounted on the cover 274 and engageable with a complemental projection 215 formed in the front wall of the upper body portion 220*a* so that the cover 274 may be secured and maintained in a closed position as shown in Figure 15.

The body 220 is integrally provided toward its front end with a vertically extending inlet fitting 224 adapted to be connected to a suction tubular hose 219 of the well-known construction.

A dust collecting case 228 is detachably secured to the body at the space below the front part of the upper body portion 220*a* and in front of the lower body portion 220*b* to form a dust collecting chamber 228*e*. The dust collecting case 228 is formed as an independent unit and comprises a bowl like receptacle having an opening 214 at its top end. The top end edge 213 defines the opening 214 in hermetical contact with the bottom wall of the upper body portion 220*a*. The rear bottom wall of the case 228 matches and contacts the front wall of the lower body portion. The reference numeral 204 indicates clamp means for securing the dust collecting case 228 to the upper body portion 220*a*.

The top opening 214 of the dust collecting chamber 228 is closed by a detachable lid 240 which has an opening 250 which is in direct communication with the inlet fitting 224. The portion 254 of the lid 240 opposing the inlet opening of the passage 234 is made of a relatively large mesh screen. The portion 254 is preferably shaped in a funnel or saucer form having a nose 254*a* extending into the dust collecting chamber 228*e*.

In the passage 234 of the upper body portion 220*a* there is contained a dust filtering and collecting bag which may be constructed from a piece of cloth or other suitable material. The mouth piece 260 of the dust bag 258 at its open end is secured by a suitable means to the edge defining the inlet opening 264. The bag 258 is therefore directed vertically upwards and then substantially horizontally rearwards within the passage 234.

The reference numeral 201 indicates wheels for carrying the body 220, and 202 indicates a handle.

The operation of the vacuum cleaner illustrated in Figure 15 is similar to that illustrated in Figures 1 to 14.

With the dust collecting case 228 being fitted and locked in place as shown in Figure 15, the motor fan unit 276 is energized to initiate violent suction of air into the cleaner for effecting vacuum cleaning. During operation of the motor fan unit 276, air carrying dirt and dust away from the surface to be cleaned rushes through the inlet fitting 224 and the inlet opening 250 into the dust collecting chamber 228*e* within the case 228. This air flow through the inlet opening 250 is deflected in an opposite direction by the bottom wall of the case 228 and passes through the screen lid 240, the entrance 264 into the dust bag receiving passage 234. From there air flows through the outlet opening 270 into the chamber 36. During this passage, as

the air is deflected within the case 28 towards the screen portion 254, dust and dirt of relatively large mass or size such as rubs or torn pieces of cloth and paper and the like carried by the air stream into the cleaner are filtered from the air by the relatively large mesh screen portion 254 before the air enters the dust bag 258. This dust of larger size is filtered or trapped by the screen portion 254 in layer after layer. As the trapped dust mass gathers on the lid, it is pressed into compactness by the high pressure jet of air and following dust mass impinging thereon. Thus, an efficient use of the available space within the dust collecting cast 228 becomes possible that is to say a relatively large amount of dust can be packed in the predetermined space 228*e* of the dust collecting case. Further, as the dust of larger size is piled and compressed tightly on the screen portion 254 in layers along a front generation line of the nose cone portion 254*a*, this compacted body of dirt serves as an additional filtering medium which removes comparatively smaller size dust including fine particles from the air stream passing through the chamber 228e.

The screen portion 254 is integrally formed with the elongated, cone-shaped nose portion 254*d* which longitudinally projects well into the dust collecting chamber 228*e*.

Even though the dust accumulation proceeds to the point where the whole region of the screen portion 254 becomes covered with a thick layer of compacted dust assemblage, this internally extending nose cone portion provides an additional filtering surface which permits relatively unobstructed passage of air therethrough for trapping a further quantity of larger dirt in an efficient manner within said chamber. In addition, air flowing through the opening 250 may blow onto the front surfaces of the nose cone 254*a* to keep that area free of any dust accumulation even when the remaining filtering surface of the cone portion becomes encircled by progressivley piled dust. Therefore, it will be understood that the front side of the cone 254*a* remains to be the only area free of dirt accumulation thereon until substantially all of the available space in the chamber 28*e* is filled with the collected dust, which maintains good filtering effect of the screen lid 240 until such time.

The air which leaves the dust collecting chamber 228*e* may flow through the entrance 264 into the fine mesh cloth filter bag 258. As the air passes through the bag, substantially all of the fine dust particles which could not be trapped by the large mesh screen portion 254 are filtered by this bag from the air before it moves through the motor fan unit 276. Thus, only dust free air is exhausted by the unit through the chamber 36 and through the discharge opening 286.

For disposing of the dust body and fine particles collected respectively in the dust collecting case 228 and the cloth bag 258, the cover 274 is opened to take the closed end portion of the dust bag 258 out of the elongated bag receiving passage 234 through the opening. The gripped end of the bag 258 is then shaken vigorously to shake off the fine dust particles collected in the bag 258 onto the exposed surface of the screen portion 254 of the lid 240 and into the hollow cylindrical space formed in the cone shaped nose portion 254a. Thus, the lid 240, in addition to its principle function as a filtering medium for removing relatively large dust and dirt from the sucked in air, serves as a receptacle for receiving the fine dust particles shaken off the dust bag 258. After the fine dust particles originally trapped in the cloth bag are placed on the exposed surfaces of the screen portion 254, the dust collecting case is removed from the body. The user may then take out the lid 240 from the case 228 and dispose of the quantity of fine dust particles which is held on the exposed side of the funnel or saucer shaped screen portion 254. Thereafter, the user may throw off the compacted mass of dust and dirt collected in the case 228 for example, by turning the casing upside down. As noted above, dust and dirt collected in this casing are pressed tightly into a compact mass or body by high pressure air stream during operation of the cleaner, the disposal of the dust mass can readily be accomplished simply by inverting and slightly shaking the case without causing the compressed dust body to be broken off into small fragments or be scattered about. The fact that the dust and dirt which accumulate in the dust collecting case are firmly pressed together into a compact assembly greatly facilitates their disposal as hereinbefore described.

From the foregoing description of the preferred embodiments of this invention, it will be clear that by employing the two-step dust collecting or filtering system which comprises the first dust collecting receptacle or case and the second cloth bag located downstream of the first receptacle in the flow path of sucked in air, the present vacuum cleaner can retain dust and dirt from the air flow in an amount substantially greater than was possible with the prior art vacuum cleaners. As a result of this increased dust storing capacity of the cleaner, it becomes unnecessary for the user frequently to repeat troublesome disposal of dust collected in the cleaner. A substantial portion of dust and dirt carried into the cleaner by air is trapped within the casing by the filtering action of the screen lid and is compressed together into a tight mass under the effect of high pressure air flow. Since the nose cone portion of the screen lid provides an additional filtering surface which extends into the dust collecting

case substantially the entire axial length of the case in the radial centre portion thereof, the air sucking and therefore dust collecting capability of the cleaner is maintained at the desired maximum until the dust casing becomes really filled with accumulating dust and dirt. As will be readily understood, without the cone-shaped filtering portion of the screen lid dust of relatively large size which will be removed from the air by the screen lid accumulates in layers on the radial filter portion of the lid which serves also as an air outlet of the casing. With the progress of vacuum cleaning operations the dust layer on the radial portion grows thick enough to interrupt the free passage of sucked in air through the casing which results in substantial reduction of air sucking or dust intaking ability of the cleaner itself. This in turn reduces the efficiency of the cleaning operation. Provision of the cone-shaped screen portion extending into the dust case avoids such disadvantages in that it provides at least a portion of relatively dust free or unclogged filtering surface within the casing until it is filled with dust to capacity. In other words, with our vacuum cleaner incorporating the disclosed dust collecting system, the cleaning efficiency thereof is kept constantly at the desired level during operation until the time that the system becomes completely packed with retained dust. The air baffle means formed at the rear end of the air inlet (see Figures 10 and 11) to direct a portion of air through the inlet onto a certain filtering surface of the nose cone of the screen lid assists in keeping at least a part of the nose cone free from any dust clogging.

The dust bag furnishes an additional filtering means especially for trapping fine dust particles which tend to escape through the wide meshes of the screen lid. The two-step filtering operation performed by the screen lid and the dust bag assures a complete and effective removal of dust carried into the cleaner by air. Moreover, the fact that the dust and dirt collected within the detachable case are compressed tightly together into a compact mass enables not only an effective utilization of the available space in the casing but also an easy and simple removal of the accumulated dust mass out of the casing which spares housewives much time and effort. In addition, according to the embodiments of the invention, as hereinbefore described, the separate dust collecting case is detachably located within the cleaner body in such manner as to be readily withdrawn when necessary by the user. This also considerably facilitates disposing operation of the gathered dust mass. With respect to the collected quantity of fine dust particles in the dust bag, this dust can be removed onto the exposed surface of the screen portion by merely shaking the closed end of the bag as previously described. In the two-stage dust collecting system both the dust collecting case and the bag, are available for repeated, long time use which is desirable in view of economy.

WHAT WE CLAIM IS:—

1. A vacuum cleaner comprising a body including a motor fan unit and a dust collecting case detachably connected to said body, there being an inlet fitting on the body adapted to be connected to a suction tubular hose, a dust collecting chamber communicating with said inlet fitting, said dust collecting chamber accommodating the detachable dust collecting case and having an outlet opening which is covered by a filter screen, an elongated passage formed in said body and connected at one end to the outlet opening of the dust collecting chamber and extending toward the position of the motor fan unit, said elongated passage including an elongated filter bag, and an exhaust air chamber formed in said body and extending from the position of said motor fan unit to an outlet of the body, and in which the filter screen has a portion on which dust particles of relatively large size accumulate and are compressed in layers so that an additional filtering medium is formed which is capable of removing dust particles of relatively smaller sizes.

2. A vacuum cleaner according to Claim 1, in which the filter screen has, in use a portion which is maintained free of any dust accumulation.

3. A vacuum cleaner according to Claim 2, in which the first portion on which dust is accumulated and compressed in layers is a radially extending area, and the portion which, in use is maintained free of dust accumulation is a substantially conical nose portion extending into said dust collecting chamber.

4. A vacuum cleaner according to Claim 3, in which the nose portion is so formed that the suction air flow through the inlet fitting blows onto a side surface of the nose portion while at the other side of the nose portion accumulation of dust on the radial portion is permitted.

5. A vacuum cleaner according to Claim 4, in which guide means is provided for introducing the suction air flow through the inlet fitting along a generation line of the nose portion.

6. A vacuum cleaner according to Claim 1, in which the dust collecting case has an inlet opening, and the filter screen comprises a lid provided with an opening adapted to communicate with the inlet fitting and screen portions which serve as the filter screen and are adapted to allow suction air flow to the elongated passage.

7. A vacuum cleaner according to Claim 6, in which the dust collecting case with the

screen lid is directly detachable from the body and in turn the screen lid is detachable from the dust collecting case.

8. A vacuum cleaner according to Claim 7, in which the inlet fitting is formed at the top of said body and is elongated substantially in a horizontal direction; the elongated passage is positioned beneath the inlet fitting; the dust collecting case is positioned in the chamber formed in the body behind the inlet fitting and the elongated passage; the exhaust air chamber extending substantially horizontally at the bottom of the body.

9. A vacuum cleaner according to Claim 7, in which the body has an opening through which there is access to the bottom end of the filter bag in the elongated passage, the opening being covered by a closable lid, and the filter screen being formed in a shape suitable for receiving dust shaken from the filter bag.

10. A vacuum cleaner, substantially as hereinbefore described and illustrated with reference to Figures 1 to 14 or to Figure 15 of the accompanying drawings.

EDWARD EVANS & Co.,
53-64 Chancery Lane,
London, WC2A 1SD,
Agents for the Applicants.

(8888) Printed by Her Majesty's Stationery Office Press, Edinburgh, 1971.
Published by The Patent Office, 25 Southampton Buildings, London, WC2A 1AY,
from which copies may be obtained.

1262121 COMPLETE SPECIFICATION
6 SHEETS *This drawing is a reproduction of the Original on a reduced scale*
Sheet 1

FIG. 1.

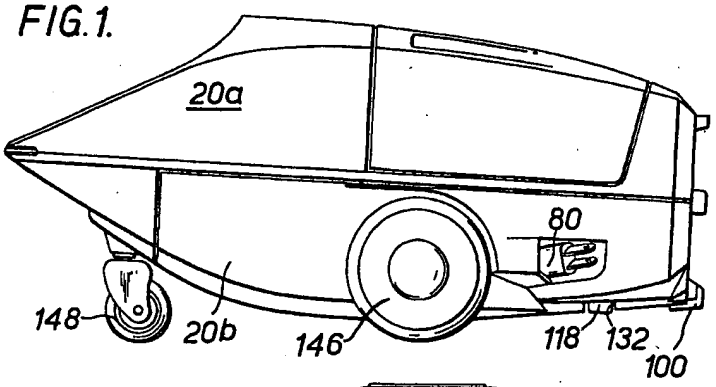


FIG. 2.

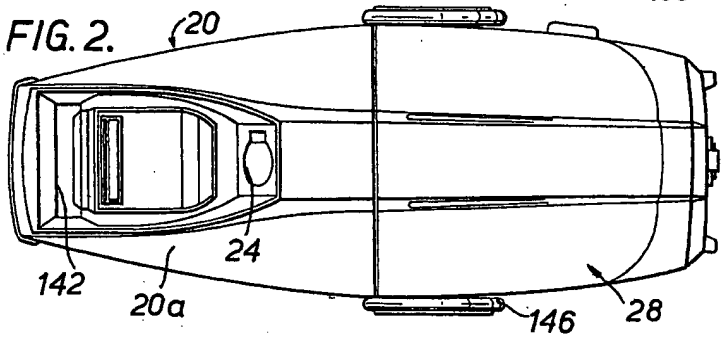
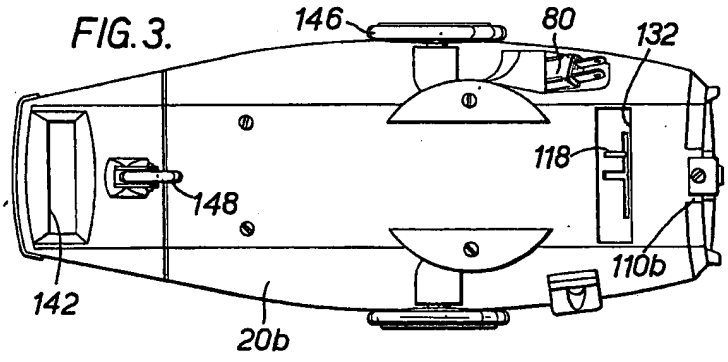


FIG. 3.



1262121 COMPLETE SPECIFICATION
6 SHEETS *This drawing is a reproduction of the Original on a reduced scale*
Sheet 2

FIG.4.

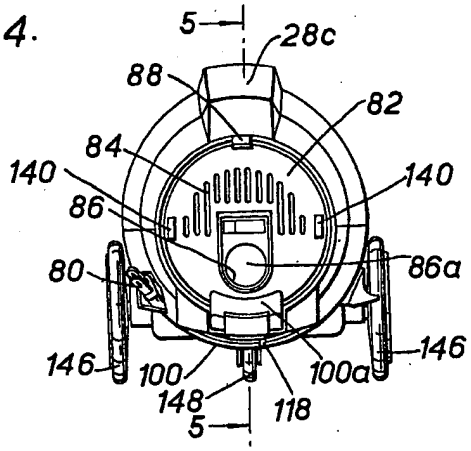
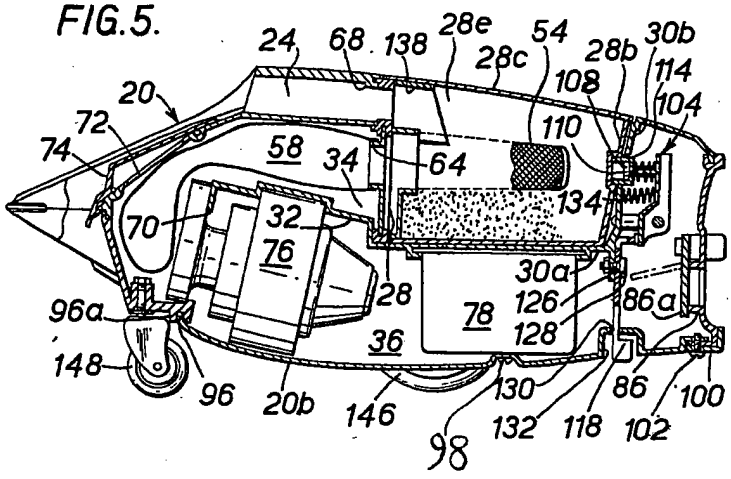


FIG.5.



1262121 COMPLETE SPECIFICATION
6 SHEETS *This drawing is a reproduction of the Original on a reduced scale*
Sheet 3

FIG. 6.

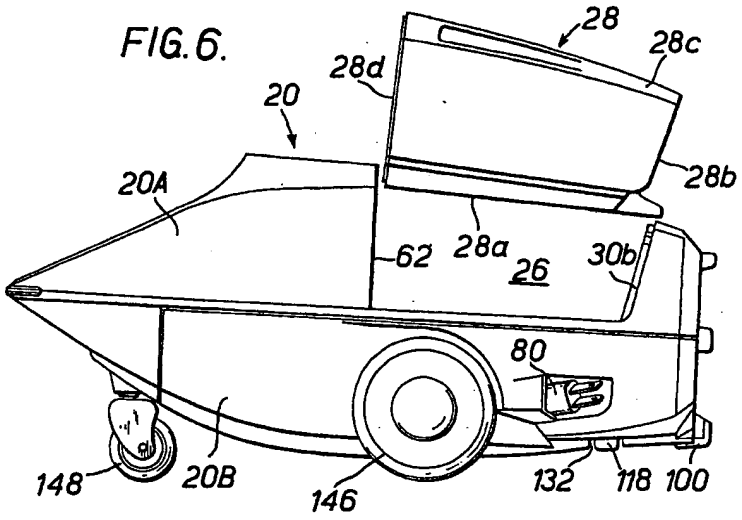
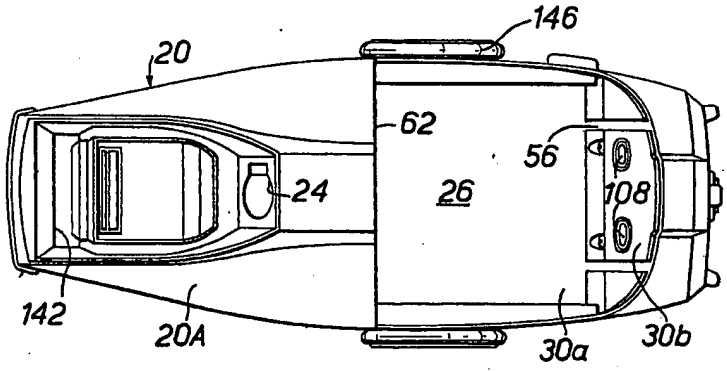


FIG. 7.



1262121 COMPLETE SPECIFICATION
6 SHEETS *This drawing is a reproduction of the Original on a reduced scale*
Sheet 4

FIG.8.

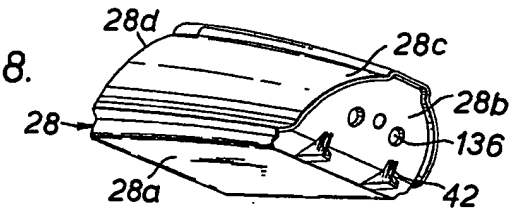
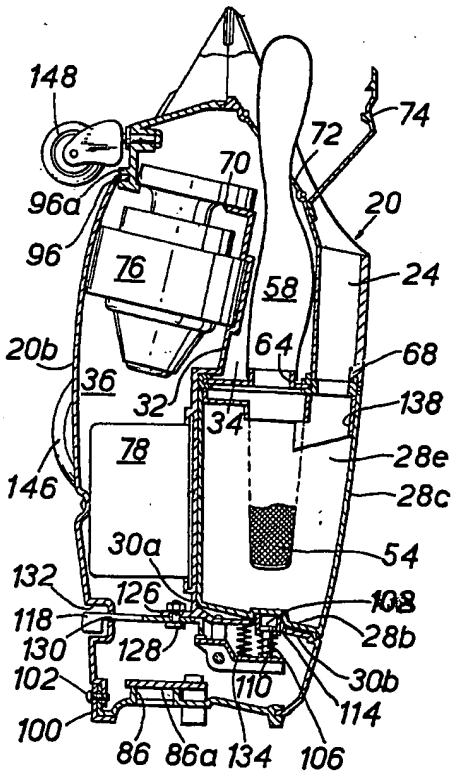


FIG.9.



1262121 COMPLETE SPECIFICATION
6 SHEETS *This drawing is a reproduction of the Original on a reduced scale*
Sheet 5

FIG.10.

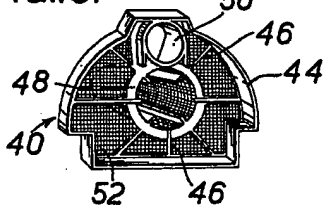
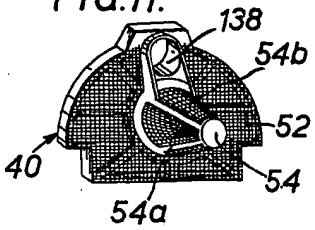


FIG.11.



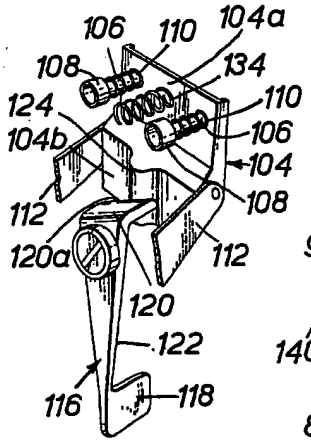


FIG.12.

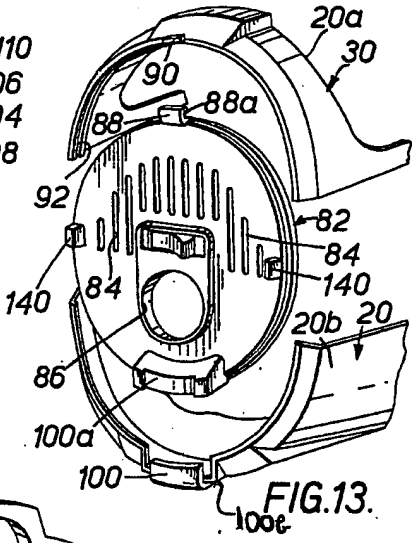


FIG.13.

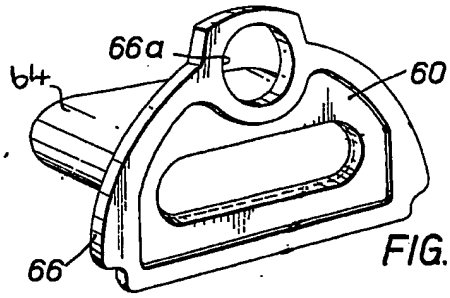


FIG.14.

1262121 COMPLETE SPECIFICATION
6 SHEETS *This drawing is a reproduction of the Original on a reduced scale*
Sheet 6

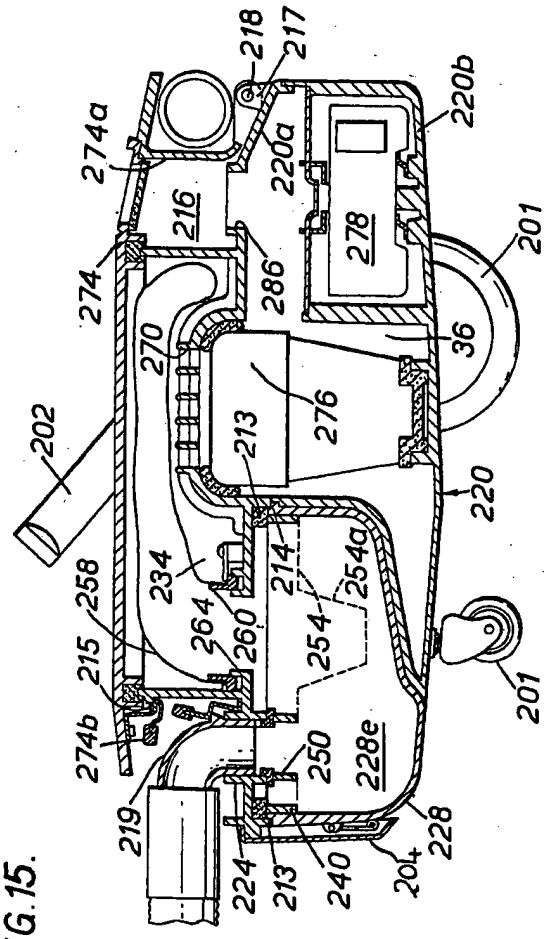


FIG. 15.